

## CITATION ANALYSIS

I agree with the statement by S. M. Lawani ("Citation Analysis and the Quality of Scientific Productivity," January 1977 *BioScience* 27: 26-31) "that work of less than average quality" is unlikely to receive "a large number of citations." Thus, committees depending on citation analysis in evaluating scientists are going to minimize the possibility of giving a poor scientist a high evaluation. However, there is a cost. As in hypothesis testing, minimizing the probability of accepting when you should be rejecting carries a higher probability of rejecting when you should be accepting. Undoubtedly there are many good, productive scientists who are cited infrequently.

Most commonly this would apply to researchers working in areas not currently in vogue, and thus certain works may require many years before their real impact is felt. For example, R. A. Fisher was one of the top 50 most-cited persons in 1967 (Lawani, Table 1) due in part to his 1930 "The Genetical Theory of Natural Selection." However the impact of this work was not immediate; the first four years after publication resulted in only one citation in the journal *Genetics*, whereas a similar length of time in the mid-1960's showed over 15 citations in this same journal.

Even in areas of active research a person's work may be overlooked for many reasons. In defense of the poor citation record of his group's studies on sexual behavior in cats, L. R. Aronson commented (*Science* 194: 165): "Most of the research on reproduction is in rats and the rat people are very parochial in that they only read the rat literature and only cite rat studies, so very frequently our papers are not cited."

One counterargument is that even though some do "quality" research, if they are not cited then they are not having an impact on contemporary science. I contend that an immediate impact on science may be a valid criterion for scientific honors (most of Lawani's evidence is based on correlations between numbers of citations and various honors), but I am unconvinced that it is a reasonable criterion for deciding tenure, promotions, or funding.

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## Decision Making with Uncertain Inputs

... How is a decision made? Do we rely mostly on facts, figures, common sense, or merely faith in authorities? We all undoubtedly use some personal blend of each of these aids. We gather information, analyze a situation, and then try to assess the relative merits of each approach. Perhaps we ask advice of our friends or colleagues, listen to debates among "experts," or consider the suggestions of political or religious leaders.

From a personal perspective, more often than not I make decisions, such as voting on obscurely worded amendments to my state constitution, without feeling that I understand the issue very well. Nonetheless, pulling down the lever is the moment of truth, and, once accomplished, one hopes that the right decision has been made.

Of course, it is possible to study many of these difficult questions more than is usually done, but that takes precious time. So we often follow the advice of those whose opinions we respect in the hopeful, but perhaps naive, expectation that they have had more time to study these perplexing issues. The severest problem occurs when one of our respected sources is dead set against another, and again we are faced with a decision: Whom should we trust?

Many people probably don't know whose opinion to trust on the bewildering issues of climate change, technology, and human survival. Unfortunately, the remaining choice is to trust no one, thereby avoiding the issues; a course of action that inevitably translates into maintenance of the status quo. Since measures designed to enhance the likelihood of catastrophe-free, long-term survival can be as expensive as they are uncertain of efficacy, it is tempting to rationalize postponement of action on these perplexing matters until the scientists, economists, moralists, politicians, or other leaders of the debate are unanimous, or at least seem more certain, about what they are saying. At the same time, we often become preoccupied with more immediate crises—inflation, recession, taxes—and lose sight of the more distant calamities ahead. Unhappily, most democracies, like the United States, are in general responsive to relatively short-term concerns; and ... mechanisms must be devised immediately to encourage elected representatives (or even hard-fisted leaders in more totalitarian states) to place first priority on longer-term issues of human survival (perhaps by adopting some form of disaster insurance at an international level). A change in political consciousness, and ultimately political process, is essential.

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